# SEMI-ANNUAL REPORT

April 2001 - September 2001

# Hanford Site Groundwater/Vadose Zone Integration Project

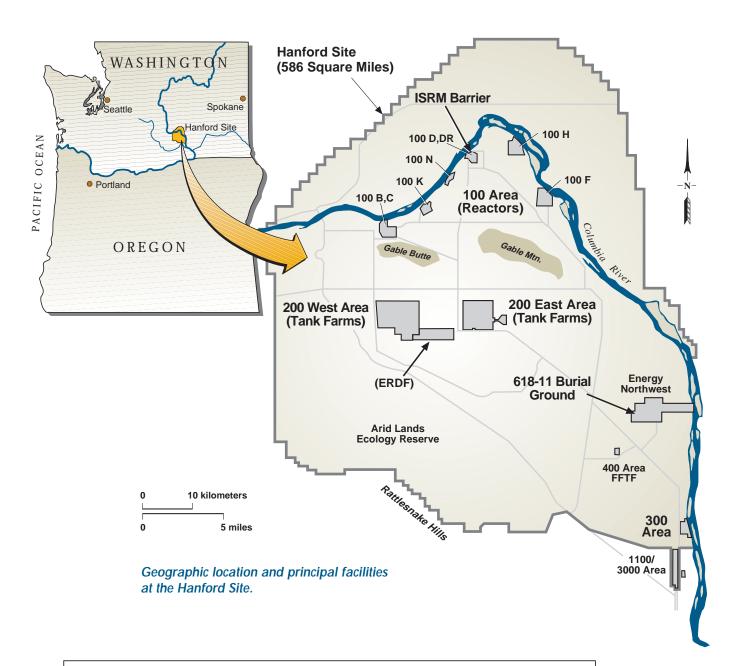
Understanding the past,

Defining the present,

Shaping the future.







The Hanford Site is located in a large tract of arid land (approximately 586 square miles) in southeastern Washington. The Columbia River flows through the site, and eventually to the Pacific Ocean. The principal features and facilities of the Hanford Site are shown in the figure above. The arid climate and isolated character of the region made it a particularly attractive site for World War II plutonium production activities, which subsequently continued throughout the Cold War. These activities left a legacy of large volumes of wastes, including toxic chemicals and radioactive substances. Some of these wastes were intentionally (or otherwise) introduced to the vadose zone (the soil above the groundwater), the groundwater, and the Columbia River. The Hanford Site is now committed to an ambitious environmental cleanup mission.

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### **ACRONYMS**

BHI Bechtel Hanford, Inc.

CD Compact Disc

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act of 1980

CHG CH2M Hill Hanford Group, Inc.

CPT Cone Penetrometer

DOE U.S. Department of Energy DQO Data Quality Objectives

Ecology Washington State Department of Ecology EMSP Environmental Management Science Program

EPA U.S. Environmental Protection Agency ERC Environmental Restoration Contractor

FH Fluor Hanford, Inc.

FEP Features, Events, and Processes

FY Fiscal Year

HAB Hanford Advisory Board

HEIS Hanford Environmental Information System HFEP Hanford Site Features, Events, and Processes

HQ Headquarters

ILAW Immobilized Low-Activity Waste

INEEL Idaho National Engineering Environmental Laboratory

IPEP Integration Project Expert Panel ISRM In Situ Redox Manipulation MSE-TA MSE-Technology Applications NAS National Academy of Sciences ORP Office of River Protection

PNNL Pacific Northwest National Laboratory

PRD Process Relationship Diagram

PSAM Probabalistic System Assessment Methodology

PUREX Plutonium Uranium Extraction Plant

RCRA Resource Conservation and Recovery Act of 1976

REDOX Reduction-Oxidation
RL Richland Operations Office
RPP River Protection Project
S&T Science and Technology
SAC System Assessment Capability
SNL Sandia National Laboratory

Tri-Party

Agreement Hanford Federal Facility Agreement and Consent Order

WIPP Waste Isolation Pilot Plant YMP Yucca Mountain Project

### IN THIS REPORT

This report describes progress made by the Groundwater/Vadose Zone Integration Project (Integration Project) for the period from April 1, 2001 through September 30, 2001.

In Section 1, "Highlights," the manager of the Department of Energy (DOE) Richland Operations Office (RL) shares his perspective on the accomplishments made by the Integration Project toward achieving the DOE's outcome-focused goals for the Hanford Site.

In Section 2, "Integration Project Status Update," an overview of the project is provided and recent accomplishments are summarized as they relate to the DOE's plan for Hanford. This section also provides funding information and an overview of the Integration Project's planned activities for 2002.

In Section 3, "Feature Article," the System Assessment Capability (SAC) and the completion of the initial assessment, or proof of principle demonstration, are highlighted in an in-depth article.

### **HIGHLIGHTS**

Soon after being named manager of the DOE's Richland Operations Office, Keith Klein formulated an outcome-focused plan for the responsible management, cleanup, and long-term stewardship of the Hanford Site that embraces the priorities of regulators, stakeholders, the Tribal Nations, and the public.

This plan has three goals. One of the goals is to remediate the Columbia River corridor to ensure that this vital resource is available for future generations. The second goal is to prepare a section of Hanford for long-term waste management. The facilities on Hanford's Central Plateau that were used to separate the uranium and plutonium from the irradiated nuclear fuel will require monitoring and maintenance for 40 years or more. The final goal is to prepare for the future by defining the approach and guiding principles Hanford will use to support the local economy's effort toward economic diversification.

These ambitious goals guide the Integration Project, which the DOE created in 1997 to integrate and coordinate the many projects underway at Hanford that characterize, monitor, and remediate Hanford's groundwater and vadose zone (the soil between the ground surface and groundwater), and Columbia River. The goals also form the basis for the Integration Project's work to apply new Science and Technology (S&T) to cleanup activities, integrate and share the wealth of technical data and information that exists about the Hanford Site, and develop and demonstrate the SAC.

During 2001, the Integration Project's made progress in all of its efforts that support the DOE plan for Hanford. One example of the project's progress is the development of the site-wide inventory, which provides a refined look at the potential sources and sites that are the most important risk drivers with respect to cleanup and closure of the site. Reducing the inventory uncertainty in terms of the amount and location of key contaminants in the soil and groundwater is providing the single most significant improvement

in our understanding of the long-term risk associated with cleanup and closure decisions on the Central Plateau.

Another of the Integration Project's accomplishments during the past year was the collection of radioactive and chemical samples from some of Hanford's most hazardous waste sites. This work, which was accelerated to coordinate with other assessment and groundwater remediation work, will provide a significant body of new information and insights that can be used when making safe, cost-effective waste management and remediation decisions.

The Central Plateau Risk Framework Guidance is an effort initiated during the past year designed to help transition the area toward long-term stewardship. This effort is aimed at establishing a set of short- and long-term risk parameters, such as future site uses and geographic buffer zones, that will be consistently used for making cleanup and closure decisions by all programs operating on the Central Plateau.

Integration Projects accomplishments during 2001 supported the DOE's goal to restore the Columbia River corridor. For example, pump and treat systems along the Columbia River were maintained at the highest performance level on record – 90 percent of planned availability. These systems are used to extract contaminants, such as strontium and chromium, from the groundwater before they reach the river. During the same period, 90 non-essential vadose and groundwater wells in the Columbia River corridor were decommissioned, reducing costs associated with their maintenance.

The largest segment of the In Situ Redox Manipulation (ISRM) barrier was completed by finishing 28 wells. ISRM involves injecting a chemical into the groundwater, which creates a chemical barrier system. The barrier prevents a toxic form of chromium from entering the Columbia River and potentially harming young Columbia River Chinook salmon.

### Section 1 – Highlights

An investigation to determine the source and extent of tritium in groundwater near an old radioactive burial site was completed. The DOE will use the findings from this work to determine if any action is needed at the burial site to protect public health and environmental safety.

In mid-2001, the National Academy of Sciences (NAS) completed its 18-month review of the Integration Project's S&T focus area. The committee concluded that there is a long-term and continuing need for S&T to support cleanup and stewardship of the Hanford Site. In its final report, the committee noted that "The knowledge and technology needed to address the most difficult problems at the site do not yet exist, and advances will not be possible without continuing investments in science and technology."

As part of the project's mission to integrate and provide information Hanford staff can use in their work, the Virtual Library was issued as a user-friendly means for reviewing and using site environmental data. Additional data sources will be incorporated into the Virtual Library during the coming year.

Another accomplishment during 2001 was the completion of the first assessment using the SAC. This suite of computer models and analysis techniques can be used to predict the movement and fate of contaminants that will remain on the Hanford Site after closure. It also is used to estimate the impacts of those contaminants to human health, the environment, the Columbia River, and the local economy and cultures. The SAC is envisioned as a tool for assessing the merits of remediation, isolation, and containment alternatives for specific areas of the Hanford Site.

The Integration Project work has made real strides in achieving its mission during the past year. The spirit and efforts of the many staff members from across disciplines and organizations are supporting DOE's decision-making aimed at near-and long-term protection of water resources. These activities are critical for ensuring work continues uninterrupted at Hanford as DOE,

together with regulators, stakeholders, the Tribal Nations, and the public work to develop a commonly understood and supported long-term strategy for the site.

If you have questions about this report, or about any element of the Integration Project, you are invited to provide us your input and become involved in the project. The last page of this report tells you how to reach us.

Keith A. Klein, Manager U.S. Department of Energy Richland Operations Office

### INTEGRATION PROJECT STATUS UPDATE

#### PROJECT OVERVIEW AND BUDGET

Because of the complexity of the waste management and cleanup efforts and the numerous projects underway to provide these activities at Hanford, DOE established the Integration Project in 1997. The goal of the Integration Project is to provide a strategic site-wide approach that effectively focuses on Hanford's most pressing near- and long-term water resources cleanup needs.

The Integration Project is managed by Bechtel Hanford, Inc. (BHI), DOE's Hanford Site Environmental Restoration Contractor (ERC), and is composed of six distinct, yet complementary, focus areas. The work within these focus areas results from the integrated efforts and teamwork of DOE's multiple contractors, including BHI, the Pacific Northwest National Laboratory (PNNL), CH2M Hill Hanford Group, Inc. (CHG), and others. The focus areas include the following:

- Site-Wide Fieldwork Integration involves all work at Hanford to characterize and monitor the movement and impact of contaminants in the vadose zone (the soil between the ground surface and the groundwater), the groundwater, and the Columbia River. These efforts have resulted in numerous opportunities to coordinate activities and improve efficiencies.
- S&T encompasses research and technology development that will provide new scientific and technical knowledge and tools for the cleanup and long-term management of the Hanford Site.
   An S&T roadmap has been created to guide funding and technology development decisions.
- SAC is an integrated system of computer models and data that can be used to predict the movement and fate of radiological and chemical contaminants remaining on the Hanford Site after closure and their potential impacts on human health, the environment, the Columbia River, and local economy.
- **Integration of Information** ensures that the wealth of technical data and information about the Hanford Site is well integrated, effectively



Integration Project accomplishments support the DOE's ambitious plan for the Hanford Site.

managed, and easily accessible for a wide range of potential uses. A Virtual Library has been created that Hanford staff can use to facilitate their technical and scientific analyses.

- Technical Review provides for outside reviews of the scientific merit, technical content, and managerial leadership of the Integration Project. The Integration Project Expert Panel (IPEP) provides broad oversight of activities. In addition, the NAS has provided input to the project.
- **Public Involvement** involves opportunities for people to share information and views about and provide input to the Integration Project. Public meetings are held regularly, reports detailing project activities are issued twice yearly, and project information is provided on the Internet at <a href="http://www.bhi-erc.com/projects/vadose">http://www.bhi-erc.com/projects/vadose</a>.

The remainder of this section provides information about recent Integration Project accomplishments in support of DOE's plan for the Hanford Site. The project's budget summary follows these summaries and shows actual funding for fiscal year 2001 (FY01) and projected funding for 2002 (FY02). The final part of this section provides a summary of significant events for Integration Project in FY02. A detailed discussion of the SAC is provided in Section 3 of this report.

## IN SUPPORT OF HANFORD SITE INTEGRATION

# Completed site-wide inventory (past, present, and future) for principal radiological and hazardous chemicals.

The site-wide inventory developed by the Integration Project has provided a refined look at the potential sources and sites that are the most important risk drivers with respect to cleanup and closure of the site. Reducing the inventory uncertainty in terms of the amount and location of key contaminants in the soil and groundwater is providing the single most significant improvement in our understanding of the long-term risk associated with cleanup and closure decisions on the Central Plateau.

The work to date has shown that most of the future potential risk is from approximately 30 to 50 of the 800 tank and non-tank waste sites on the Central Plateau and that the inventory of long-life radionuclides, such as technetium-99, in these sites is lower than previously thought. This work is being closely coordinated between RL and the Office of River Protection (ORP) so that continued improvement and understanding the tank and non-tank inventories is incorporated into modeling and risk analyses that are conducted to support cleanup and closure planning for the Central Plateau.

A draft report on the inventory data assembled for the SAC initial assessment was completed. This draft report will be revised and updated to incorporate refinements developed by ORP and RL during FY02. A virtual library module is under development to provide access to the inventory data.

# Completed peer review of the SAC history matching results.

A panel of independent outside experts reviewed the procedures and results of the history-matching effort. A summary of history-matching results was provided for their review, which was held on August 23 and 24 at Hanford. Task leads for each



The Integration Project is a critical link in cleaning up wastes remaining from Hanford Site activities that contributed to the nation's defense efforts for nearly 50 years.

technical element presented results of history matching and addressed the reviewers' questions. The reviewers' comments were transmitted to the project in a letter at the end of September.

The review team indicated that the history matching effort was adequate for the demonstration and had a number of suggestions for additional confidence-building activities before performing assessments with SAC Rev. 1.

#### Conducted the SAC initial assessment.

As discussed in the feature article, the Initial Assessment of SAC Rev. 0 was completed during the reporting period. SAC Rev. 0 is an uncertainty analysis with varying values for many of the parameters that influence inventory, contaminant transport, and impact. Eleven realizations were completed for the Initial Assessment. Modeling runs were completed on August 24. The results of the SAC Initial Assessment were presented to DOE, regulators, including the U.S. Environmental

Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), as well as to the Hanford Site Management Board, the IPEP, and other interested parties during the reporting period.

### Completed the composite analysis addendum.

The composite analysis addendum, which addressed the impact of the Plutonium Uranium Extraction Plant (PUREX) tunnels, the chemical separation plants, and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) sites in the 200 Areas that were not considered in the first composite analysis, was concluded. The addendum analysis used estimates developed for technetium-99 and iodine-127 from the SAC inventory database as representative mobile contaminants to evaluate the potential impact from the sites considered. The results indicated the effect of the additional sites will not be significant during the 1,000-year period of analysis, and conclusions of the 1998 composite analysis as conditionally approved are valid.

Work in 2002 will include technical evaluation of new inventory, source-term release, and contaminant migration information and data being developed by ongoing Hanford and national waste management and operational programs and research and development projects.

# Accomplished transient inverse calibration of Hanford Site groundwater model.

Transient inverse calibration of the Hanford Site groundwater model to historical aquifer impacts from past operations is being used to evaluate alternative conceptual models of the site-wide groundwater system. The efforts are part of a broader objective to develop a more robust capability to incorporate conceptual model and model parameter uncertainty into Hanford Site groundwater flow and transport model predictions.

The transient inverse calibration procedure used the previous site-wide groundwater model and more than 76,000 water-level measurements taken in about 1,200 wells at the Hanford Site since the late 1940s. The initial transient inverse calibration of the previous model significantly improved the capability of the site-wide model (or the baseline model) to simulate historical trends in water-table changes over the entire 1943-1996 period.

More recent conceptual model evaluation and calibration efforts investigated the effects of intercommunication between the unconfined aquifer and the underlying upper basalt confined aquifer to determine whether the inclusion of basalt interactions could improve the ability of the site-wide groundwater model to predict past system behavior.



Groundwater remediation.

The results of the initial baseline and basalt interaction conceptual model evaluations indicate that additional improvements to the current conceptual groundwater models are needed. Studies are underway to implement and evaluate potential model improvements.

# Launched the Virtual Library, facilitating Internet access to Hanford data.

Data from the Hanford Environmental Information System (HEIS) database was made available through the Virtual Library in August 2001. Two additional modules, one for the inventory data used in the SAC Initial Assessment and one on effluent volumes released to the soil at liquid discharge sites, will be released during the first quarter of FY02.

# Received NAS report and completed briefings to DOE-Headquarters (HQ) and Hanford Site management.

The NAS/National Research Council Committee on Environmental Remediation Science and Technology at the Hanford Site completed its 18-month review of the Integration Project S&T. The results of their review were presented to EM-1 (Assistant Secretary Roberson) and others on August 1, 2001. A formal report "Science and Technology for Environmental Cleanup at Hanford" has been released. The review was commissioned by the previous EM-1 and was conducted by a 14-member committee formed by the National Research Council Board on Radioactive Waste Management.

The committee concluded that there is a long-term and continuing need for S&T to support cleanup and stewardship of the Hanford Site. The committee also noted that given the technical and organizational complexity of the task, the Integration Project has made a good start in creating a S&T roadmap, defining and initiating a S&T program, and fulfilling the promise of its mission.

They recommended increased documentation of S&T projects, prioritization of research activities, and effective use of peer review. Additionally, they made recommendations for reprioritization of work as well as several specific technical recommendations.

# Produced data catalogs for geological data, release models, and vadose zone hydraulic properties.

The draft report that evaluates the inventory assembled to support the SAC Initial Assessment was completed. This report will be finalized during the first quarter of FY02.

A report, "Data Catalog for Models Simulating Release of Contaminants from Hanford Site Waste Sources" (PNNL-13666), was completed. Three reports on vadose zone were completed:

• "A Catalog of Geologic Data for the Hanford Site" (PNL-13653);

- "A Catalog of Vadose Zone Hydraulic Properties for the Hanford Site" (PNNL-13672);
- "Hanford Contaminant Distribution Coefficient Database - FY01 Status Report."

# Documented use of conceptual models and process relationship diagrams.

The use of Process Relationship Diagrams (PRDs) in the development of conceptual models within two related operable units located at the Hanford Site 200 West Area was documented in a report, "Use of Process Relationship Diagrams (PRD) in the Development of Conceptual Models" (PNNL-34515).

A draft professional paper was completed. The paper describes the resulting tools and methodology that DOE is using to promote consistency and completeness in the development of conceptual models at the Hanford Site. It also outlines the benefits of adapting this approach and presents examples of applications of the methodology and tools to several ongoing environmental assessments at the Hanford Site. The professional paper will be finalized during FY02 with submittal to a professional journal for publication.

A report, "The Application of FEP Methodology at the Hanford Site" (BHI-01573) was completed. The report documents the screening of the international set of Features, Events, and Processes (FEPs) and the initial development of the Hanford Site Features, Events, and Processes (HFEPs).

## Initiated and conducted Central Plateau Risk Framework Workshop.

The goal of this workshop, which was held in early October, was to reach and formalize an agreement among the DOE, EPA, and Ecology on the exposure scenarios to support feasibility study analysis and remediation/closure decisions for the Central Plateau.

To achieve this goal, the agencies are conducting technical meetings to discuss all of the regulatory

and technical requirements related to this issue, involving the appropriate programs impacted by such an agreement. Throughout the discussions, the agencies will frequently consult with the public, stakeholders, and Tribal Nations before final decisions are made.

As part of the workshop, tentative agreement was reached on the geographic zones, time phases for operating and remediating the Central Plateau zones, typical activities in geographic zones, time phases, and future technical steps. White papers that provided background information, options, and starting points for workshop discussions were presented.

## Updated conceptual model of groundwater/river interface.

The groundwater/river interface task updated conceptual and numerical models of the groundwater/river interface at the 100-D and 100-K Areas (100-H Area) in 2000. The conceptual models include descriptions of groundwater flow and transport in the near-river environment and updated dilution factors for use in future revisions of the SAC and for development of groundwater and river monitoring strategies.

## Completed vadose zone transport field study.

The vadose zone transport field study completed the 2001 field experiment involving injection of a high-salt solution (sodium thiosulfate) with tracers into the subsurface. Field data were collected using various geophysical methods, neutron probes, and through core sampling. The high-salt solution spread laterally, but penetrated deeper in the profile than the dilute solution injected during the 2000 field experiment. The data are being analyzed and modeled to estimate field-scale parameters, and by comparison to laboratory measurements, used to develop an upscaling methodology. The importance of upscaling was emphasized by the NAS committee that commented on the Integration Project S&T program. The results are being summarized in a final report that will be published in October 2001.

### Conducted IPEP meetings.

The IPEP conducted its ninth meeting April 25-27, 2001. Technical topics included the SAC history matching exercise and the soil characterization work at the S-SX Tank Farm, including the S&T component of the work. The IPEP also discussed its role in the transition of the Integration Project, which is planned for June 2002.

The panel's tenth meeting was held September 26-28. Presentations made by Integration Project staff provided up-to-date information on a range of fieldwork activities, as well as on S&T, the SAC Initial Assessment, and the Central Plateau Risk Framework Workshop.

In its closing remarks, the panel noted that the Integration Project had produced an impressive set of work activities, products, and new information since its last meeting in April. The panel also cited the Integration Project's appreciation for input from regulators, stakeholders, the Tribal Nations, and the public.

The panel recommended additional work for the Integration Project in the areas of transition planning, the SAC, and groundwater remediation systems. The panel's report on its September meeting will be released in late 2001.

### Other Accomplishments

- Developed the first Hanford Site Biological Resources Management Plan.
- Conducted monthly open project team meetings.
- Provided outreach and information to stakeholders, regulators, the Tribal Nations, technical groups, and the public about Integration Project, including the development of an interactive compact disk (CD) describing the Hanford Site and the Integration Project.

# IN SUPPORT OF COLUMBIA RIVER CORRIDOR REMEDIATION



ISRM well completion.

### Completed the largest segment of the ISRM barrier.

Work continued on the ISRM barrier across the chromium plume west of the D Reactor (100-HR-3 D Area ISRM Groundwater Remediation Project). Phase II barrier emplacements were completed, including the installation of 32 two wells -- 28 barrier wells and 4 compliance monitoring wells. ISRM emplacements (injections and extractions) were completed in 28 wells. Phase III well installations are scheduled for completion during the first six months of FY02. Phase III barrier emplacements will begin in the second half of FY02.

### Decommissioned 90 wells along the Columbia River Corridor.

As one of the three outcomes of the cleanup of the Hanford Site, 90 nonessential vadose and groundwater wells were decommissioned in the Columbia River Corridor. The well sites included different types of wells, from former groundwater-monitoring wells to seismic-data collection wells drilled from 10 to 500 feet. The majority of the decommissioning was performed between April and September 2001. All of the wells decommissioned were in the 600 Area either

between the Hanford town site or the 300 Area or west of B Reactor.

### Concluded tritium investigation in the 618-11 Burial Ground.

Data quality objectives (DQOs) for the soil-gas collection and groundwater characterization for the tritium plume emanating from the 618-11 Burial Ground were finalized. The soil-gas results were collected and interpreted. The groundwater tritium plume characterization field activities were completed. The results of the characterization were summarized in a letter report to RL.

### Finished design for pump-and-treat systems upgrades (HR-3 and KR-4).

A system design upgrade construction package was completed (100-HR-3 Groundwater Remediation System Upgrades). The design included system upgrades and the tie-in of up to two additional D Area extraction wells in FY02. Field construction activities and system upgrades will be completed and operational in FY02.

A system design upgrade construction package was completed (100-KR-4 Groundwater Remediation System Upgrades). The design included both system upgrades and the installation of a new extraction well and a new injection well to increase groundwater plume capture. Well installations, field construction activities, and system upgrades will be completed and operational in FY02.

# Maintained pump-and-treat operations along the Columbia River at the highest performance level in history.

During the year, 1.1 billion gallons of groundwater were processed, removing carbon tetrachloride, strontium, and chromium. Through FY01, all five pump-and-treat systems operated at or above the planned 90 percent availability. Since inception, more than 5.4 billion gallons of groundwater has been processed.



Resin changeout at 100 Area pump-and-treat system.

# Completed biological fate and transport experiments for technetium-99 fish update through water pathway.

The biological fate and transport task completed laboratory experiments for the uptake of technetium-99 by rainbow trout through the water pathway. The experiments for uptake through the food pathway are underway. During the reporting period, staff on the biological fate and transport task also met with ecological risk assessment experts at the Center for Environmental Risk, University of East Anglia, and with bioassay experts at British Nuclear Fuels, Limited, in Whitehaven, England. These ecological risk assessment experts have made similar measurements and several avenues for sharing of data and collaboration were identified.

### Other Accomplishments

- Completed an evaluation of the bioavailability of metals in sediment along the Hanford Reach of the Columbia River for river contaminants/biological transport models for the SAC.
- Modified near-shore Columbia River monitoring protocols to obtain localized contaminant concentration information along areas of known contaminated groundwater seepage to be used in future iterations of the SAC.
- Completed groundwater/Columbia River interface studies for 100-D, K, and H Areas.
- Completed field samples on 300 Area Columbia River and shoreline characterization with the Department of Health, EPA, Ecology, and the public safety and resources protection program.
- Completed field survey for establishing recreational use baseline of the Columbia River.
- Initiated a new statistical approach for groundwater monitoring in the 300 Area.
- Completed development of summary fact sheets for selected environmental contaminants to support risk assessment analyses. The fact sheets will be made available via the Internet.

# IN SUPPORT OF CENTRAL PLATEAU WASTE MANAGEMENT



200 Area Remedial Action Project.

### Completed field characterization of highrisk liquid waste sites in the 200 Area.

Fieldwork at the 200-TW-1 and 200-TW-2 sites, which received tank farm wastes, was completed ahead of schedule. Two cribs, 216-T-26 (200-TW-1) and 216-B-7A (200-TW-2), and one trench, 216-B-38 (200-TW-2), were characterized from the surface to the groundwater by drilling and sampling a borehole through each waste site. In addition, five drive casings were driven along the centerline of the 216-B-38 Trench to 60 feet below ground surface, and measurements of the radioactivity were made using geophysical monitoring tools.

### Compiled existing ecological data to establish a baseline for the 200 Area.

The objective of the 200 Area Ecological Evaluation is to establish the current status of ecological resources potentially at risk of exposure to hazardous substances from 200 Area waste sites. The evaluation identifies contaminants of concern present in shallow (less than 15 feet deep) vadose zone soils, potential plant and animal receptors, and available habitats within the 200 Areas. The Phase I compilation and summarization activities of existing ecological

data pertinent to the 200 Areas and focusing on post-1994 data, were completed. Preliminary biological exposure models to identify preliminary receptors and pathways of concern based on existing ecological data, applied ecological principles, and site knowledge also were developed. A report on, and verification of preliminary biological exposure models developed in, Phase I will be completed in Phase II, which will begin in 2002.

### Finished field investigations of siltyloam borrow sites for surface barrier construction materials.

The purpose of this investigation was to locate a suitable borrow source for the upper fine-grained layers of the barrier. Barriers help restrict the movement of water through waste sites, an important step in preventing contaminant migration deeper into the subsurface of the Hanford Site. In 2001, work included preparation of a study plan, field reconnaissance of three alternative borrow sites to locate a preferred site, fieldwork and laboratory testing to characterize the material inventory and the physical and hydrologic soil properties at the preferred borrow site, and a report. The work was based on the assumptions that the McGee Ranch borrow site no longer is available for mining.

### Initiated MSE-TA uranium investigation.

MSE-Technology Applications (MSE-TA) is funded by the DOE's Subsurface Contaminants Focus Area to contribute to fulfilling needs identified by the Hanford S&T Coordination Group. MSE-TA is focusing its efforts in the 200 West Area of the Hanford Site where a plume of uranium exists in the 200-UP-1 Groundwater Operable Unit.

The objective of the project is to develop a conceptual geochemical model to quantify the mobility of uranium in the saturated zone and unsaturated soils associated with the 216-U1/U2 Cribs. During the installation of a new extraction well in June and July, MSE-TA collected soil and gas samples for analysis as well as acquired borehole geophysical data from the well.

In September additional gas sampling was performed at the well site using the cone penetrometer (CPT).

# Resolved critical technical issues by completing in-depth analysis of tank farm leaks at S-SX Tank Farm.

During the reporting period, the tasks for field investigations at representative sites and transport modeling completed an appendix of the S-SX Field Investigation Report prepared by the River Protection Project (RPP). The research, including contributions from the Environmental Molecular Sciences Program (EMSP), addressed a number of key scientific issues associated with the composition of tank wastes that leaked to the vadose zone, the chemical species present in tank wastes from the reduction-oxidation (REDOX) process, movement of water and contaminants through the vadose zone in and near the S-SX Tank Farm, and the geochemical behavior of cesium-137, chromium, and technetium-99.

# Completed field investigation through largest known leaks in B-BX-BY Tank Farms.

Two characterization boreholes were completed -one in the 241-BX Tank Farm and one in the
241-B Tank Farm. Both boreholes were extended
to groundwater, and samples of the medium were
collected. Initial chemical and radiological
analyses have been completed, and sample zones
have been selected for more detailed analyses.

The borehole in the 241-B Tank Farm was converted into a vadose-zone hydraulic monitoring well during its decommissioning. This effort was conducted in cooperation with the S&T efforts of the PNNL and Idaho National Engineering Environmental Laboratory (INEEL). Initial data from this installation are anticipated to become available in FY02.

#### Initiated B, BX-BY Studies.

The field investigations at representative sites initiated experiments with samples from the borehole drilled near tank BX-102 for the Tank

Farm Soil Characterization Project. The experiments are focused on the transport behavior of uranium through the vadose zone. Samples were also received from the borehole drilled near tank B-110 for investigation of strontium-90 transport and behavior.

# Constructed tank farm run-on controls and water-line capping and testing in the 200 West Area.

Run-on control consisting of berms, curbing, and paving were constructed around T, TX, TY, U, S, SX, and SY Tank Farms. These controls will serve to prevent water from external sources from entering and infiltrating the tank farm surfaces.

Several interim corrective measures were taken in the 200 West Area. Water lines serving the S and SX Tank Farms that were determined to be unnecessary were cut and isolated. Three water lines serving the S, SX, and U Tank Farms that were identified as being necessary for retrieval activities were tested to determine if they were leaking. The active lines showed no measurable leakage.

### Installed 11 RCRA groundwater monitoring wells.

The Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) requires the construction of 11 Resource Conservation and Recovery Act of 1976 (RCRA) groundwater monitoring wells in the vicinity of the 200 West and 200 East Area tank farms in 2001. Drilling activities were initiated in July 2001. By the end of September, three wells were completed adjacent to the B-BX-BY Tank Farms in the 200 East Area and three wells adjacent to the U tanks in the 200 West Area. The remaining five wells will be completed by November 15, 2001.

## Completed design for 200 UP-1 pumpand-treat system upgrades.

The second half of FY01 saw the installation of a groundwater monitoring well and completion of the design upgrade package to modify the old



Air rotary rig at the 241-U Tank Farm.

injection well into a second system extraction well (200-UP-1 Groundwater Remediation System Upgrades). Field construction activities are planned for the first half of FY02 to connect and operate the second extraction well.

# Restarted vapor extraction operations and maintained groundwater treatment for carbon tetrachloride.

Two interim actions were implemented to accelerate the cleanup of carbon tetrachloride in the subsurface of the 200 West Area. Soil vapor extraction was initiated in 1992 to reduce high concentrations of carbon tetrachloride in the vadose zone to minimize additional degradation of the groundwater. Pumpand-treat technology was initiated in 1995 to reduce contaminant mass in the groundwater and to prevent further movement of groundwater contamination from the high-concentration portion of the carbon tetrachloride plume.

In 2001, the soil vapor extraction system was operated from April through September, following temporary suspension of operations during 2000. The groundwater pump-and-treat system operated throughout 2001. Since 1992, soil vapor extraction has removed 77 metric tons of carbon tetrachloride from the vadose zone. Since 1995, groundwater pump-and-treat has removed 6 metric tons of carbon tetrachloride from the unconfined aquifer. The groundwater pump-and-treat system is successfully containing the high-concentration portion of the groundwater plume.

## Deepened wells for carbon tetrachloride characterization and vapor extraction.

During May and June 2001, two existing wells at one of the carbon tetrachloride disposal sites were deepened. Soil vapor extraction is being used at this disposal site to remove carbon tetrachloride from the vadose zone. Before 2001, the two wells provided subsurface access for vapor extraction in the upper portion of the vadose zone. During deepening of each well, soil and soil vapor samples were collected to characterize the concentration and distribution of the carbon tetrachloride remaining in the vadose zone vertically beneath the zone used for soil vapor extraction.

After deepening and characterization sampling, the wells were reconfigured for additional long-term use to provide subsurface access for vapor extraction in the lower portion of the vadose zone. During soil vapor extraction operations at this disposal site in 2001, the deepened wells were used for soil vapor extraction.

# Used geological statistics to remove redundant wells in the carbon tetrachloride plume area.

Carbon tetrachloride forms one of the most significant groundwater contaminant plumes at the Hanford Site. The plume is found at levels above the  $5 \,\mu g/L$  drinking water standard over approximately 4.5 square miles (11.5 square kilometers) of the site. Originally, 117 wells were slated to be used for monitoring this plume in 2001. The number of wells needed was reduced

by nearly 15 percent through a geostatistical procedure developed by PNNL.

The newly developed statistical model describes carbon tetrachloride distribution and then, through a series of computer simulations, the wells are ranked in order of importance in tracking the contamination. The ranking focuses on the overall extent of contamination and to monitoring contamination to meet cleanup targets. The final network provides sufficient information on the extent of contamination and meets all regulatory requirements, but at significantly lower cost.

### Other Accomplishments

- Completed installation of vadose zone monitoring sensors at the B-110 and S-SX Tank Farms.
- Finished leak detection mitigation and monitoring field tests for the ORP.
- Received DOE-HQ approval of the Immobilized Low-Activity Waste (ILAW) Performance Assessment.
- Concluded characterization of borehole at ILAW site.
- Accomplished high-salt injections and data analyses at Vadose Zone Transport Field Study site.
- Awarded the contract for the enhanced cone penetrometer access technology demonstration through National Environmental Technology Laboratory.
- Completed the first year of surface barrier performance monitoring technologies evaluation.

### Funding for the Integration Project and Core Projects by Fiscal Year.

(millions of dollars)

	FY 200I Funding	FY 2002 <sup>(1)</sup> Funding	Responsible DOE Office
System Assessment Capability	\$2.28	\$2.30	RL
Science and Technology	\$4.88	\$4.64	RL
Technical Review	\$0.84	\$0.23	RL
Public Involvement	\$0.26	\$0.19	RL
Integration of Information			
Project Management	\$0.38	\$0.69	RL
Data Management and Issues Resolution	\$2.35	\$1.98	RL
ntegration of Information Subtotal	\$2.73	\$2.67	
ntegration Project, Total Funding	\$10.98	\$10.03	
Core Projects (Fieldwork)			
Groundwater and Vadose Zone Monitoring	\$13.54	\$12.12	RL
Well Installation and Maintenance	\$5.14		RL
River Protection Project Vadose Characterization	\$8.63	\$9.80	ORP
Tank Farm Geophysical Logging	\$0.70	\$0.30	ORP
ILAW Characterization	\$0.25		ORP
ILAW Performance Assessement	\$2.59	\$4.00	ORP
Tank Farm Infiltration Control Measurement	\$1.80	\$1.80	ORP
Columbia River Monitoring	\$0.40	\$0.40	RL
ER 200 Area Borehole Logging - GJO	\$1.00		RL
In-Situ Redox Manipulation (ISRM)	\$4.04	•	
100 Area Pump and Treats (HR, KR, NR)	\$4.32	•	RL
200 Area Pump and Treats (UP, ZP)	\$2.61		RL
200 ZP Vapor Extraction	\$0.72		RL
200 Area Waste Site Characterization	\$3.95	\$6.66	RL
Core Projects, Total Funding	\$49.70	\$52.74	
ntegration Project and Core Projects, Total Funding	\$60.68	\$62.77	
Headquarters Programs			
Environmental Management Science Program	\$10.00	\$10.00	HQ
(\$25 M over FY 2000 - FY 2002)	Ψ10.00	Ψ10.00	
Total Funding, All Activities in Status Report	\$70.68	\$72.77	
<sup>a</sup> RL = DOE Richland Office			
ORP = DOE Office of River Protection			
HQ= DOE Headquarters (Office of Environmental Man	agement)		
(1) Includes FY02 ERC Carryover	agement		

#### **SIGNIFICANT EVENTS FOR FY 2002**

During FY02, the Integration Project will continue to pursue critical activities and core projects to support the Hanford Site objectives for the Columbia River corridor, the Central Plateau, and overall site integration. For the Columbia River corridor, the EPA five-year review upgrades to the groundwater remediation systems will be completed, along with the completion of the ISRM barrier.

On the Central Plateau, groundwater remediation, site assessment, and tank farm characterization activities will continue, along with the development of the risk assessment framework, groundwater protection, and modeling strategy for the Central Plateau. A figure showing key activities planned for the Hanford Site in 2002 is shown below.

At the direction of the DOE, planning is underway to transfer the Integration Project from BHI to Fluor Hanford Inc. (FH) effective July 1, 2002. The transition will align the Hanford Site's work with the DOE's current and upcoming contracts. The elements of the Integration Project that will transfer to FH include all groundwater and vadose zone activities for the Central Plateau and River Corridor and the management of all key site-wide databases.

As a result of both the maturing of the Integration Project and the transition to FH the next report will be an annual report. The annual report will provide information about the accomplishments in 2002 and future plans of the project. The report will be issued in early 2003 after transition to FH.

### **Key FY02 Products and Activities**

#### River

- Complete Site Environmental Report
- Collect FY02 Environmental Samples
- Complete Draft of 300 Area Shoreline Investigation Report

#### SAC:

- Perform Alternative Assessments
- · Improve capability
- Document Initial Assessment
- Develop Rev. 1 Requirements with Regulator and Stakeholder input

- Complete S&T input to B Tank Farm investigation
- Complete Groundwater/River interface study
- **Update Road Map to include Remediation Elements** and NAS comments
- · Continue soil waste inventory estimates
- Initiate Vadose Zone Reactive Transport tests

#### **Characterization of System:**

- Update site State of Knowledge
- · Facilitate Model coordination group
- · Finalize tools for consistent conceptual model development.
- Support development of SAC Rev.1

### **Central Plateau Investigations:**

- Complete Ecological Evaluation Report
- Complete CW-5 (U Pond/Ditches) Field Investigation
- Initiate CCI dispersed plume investigation
- · Initiate tests for alternative barriers
- Submit S/SX Field Investigation Report
- · Field sampling in TX Tank Farm
- Modeling for B/BX/BY Tank Farms

#### Integration:

- Set Central Plateau Standards
- Upgrade Virtual Library
- Continue integrated communications and Outreach
- Develop Database Strategy

#### **Groundwater:**

- Completed CERCLA 5-Year review action items
- Maintain six treatment systems
- Continue ISRM
- Continue Groundwater Monitoring
- Install FY02 RCRA wells

### Section 3 – FEATURE ARTICLE

### THE SYSTEM ASSESSMENT CAPABILITY:

### RISING TO ANOTHER CHALLENGE AT HANFORD



The SAC will help decision makers with some of the critical information they need to help protect people, the environment, and the Columbia River.

In the late 1980s, nuclear materials production in support of the nation's defense mission ended at the Hanford Site, closing a chapter in the history of the 586-square-mile site. At the same time, however, a new chapter that was promising to be as challenging as the site's original mission was taking shape – cleaning up the waste remaining at Hanford after nearly 50 years of operation.

The SAC, one of the Integration Project's key activities, promises to be an important tool in site cleanup and long-term waste management because of its ability to illustrate the movement and fate of radiological and chemical contaminants remaining at Hanford after closure. "In the near-term, the SAC will provide information on the overall impact of Hanford on the region that DOE and federal and state regulators can use in their efforts to make site-specific cleanup decisions. In the

long term, the SAC will provide important information for site closure and stewardship decisions," said Bob Bryce, SAC project manager.

The SAC is an integrated system of computer models and databases. These tools enable users to model the movement and fate of contaminants at Hanford through the vadose zone, groundwater, and Columbia River. The system also allows users to assess the impacts of the contaminants on human health and the local economy and cultures.

The development of the SAC, and the completion of the first assessment using it, has required several years of work by a diverse team of individuals, ranging from representatives from DOE, regulators, and the Tribal Nations to scientists, engineers, and the public.

### **CREATING THE SAC**

The first step in the creation of the SAC was taken in early 1999 when public meetings were held during which people expressed what they thought was needed in the SAC, such as which radioactive and chemical wastes and time frames to include. "The public's input has been a crucial element throughout the development of the SAC," Bryce noted.

Following the meetings, the SAC workgroup was created. "The workgroup included DOE, regulators, representatives from the Tribal Nations, the Oregon Office of Energy, and others," Bryce explained. "This series of workgroup meetings and consultations with the Hanford Advisory Board (HAB) resulted in a proposed approach for the SAC. In the summer of 1999, everyone who attended a one-day meeting had the opportunity to vote on whether the effort should proceed with the proposed approach."

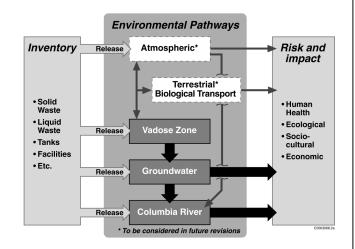
An initial design for the SAC was developed as a result of the meetings. But, before moving forward, the design was critiqued by a team from Sandia National Laboratory (SNL). "We asked SNL to review the design because its staff has developed similar, large-scale assessments for the Yucca Mountain Project (YMP) and the Waste Isolation Pilot Plant (WIPP)," Bryce said.

With the final design approach in hand, the SAC core team set to work. Together, the 14-member core team has more than 250 years of combined professional experience in such diverse disciplines as computer software development, civil engineering, geology, and zoology. "Many members of the team have worked on large, complex projects, plus, the majority of them have an in-depth understanding of the Hanford Site," said Bryce.

# SAC TECHNICAL ELEMENTS: Inventory, Environmental Pathways, and Risk and Impact

Two sets of computer models are at the heart of the SAC. One set is designed for simulating transport of contaminants through the environment; the second set is designed to estimate risk and impact from those contaminants (see diagram). There are five *technical elements* in the environmental transport portion of the SAC.

The first element is the *inventory* of potential contaminants from past Hanford Site operations. The second is the *release* of contaminants to the environment from the various types of waste, such as reactors, tanks, and burial grounds. The third element follows the transport and fate of contaminants as they move through the unsaturated strata of the *vadose zone*. When contaminants reach the *groundwater*, the fourth element, they can flow toward the groundwater-river interface. From there, they enter the *Columbia River* ecosystem, the fifth element.



The Risk and Impact portion of the SAC includes four technical elements to model *human risks*, *ecological risks*, *economic risks*, and *socio-cultural risks*.



Information-sharing meetings are a regular part of the development of the SAC. Shown seated at the table clockwise from the bottom are Bob Bryce, SAC program manager; John Standfill, Nez Perce Tribe; Moses Jarayssi, Integration Project; John Morse, DOE-RL; Wade Riggsbee, Yakama Nation; Ted Repasky and Rod Skeen, Confederated Tribes of the Umatilla Indian Reservation. Shown seated along the wall from left to right are Mary Todd and Charley Kincaid, Integration Project, and John Price, Washington State Department of Ecology.

The core team's responsibilities were aligned with the conceptual areas of the SAC – inventory, environmental pathways -- release, vadose zone, groundwater, and Columbia River -- and risk and impact. "It is critical to understand these pathways because they are the principal mechanisms through which contaminants from past Hanford operations could reach the Columbia River and potentially affect humans and the environment," Bryce said. "The team members' responsibilities are based on their training and experience in the respective areas."

Charley Kincaid serves as both the SAC technical lead and the lead for inventory. The goal of the inventory task area is to identify the contaminants from past Hanford operations that should be included in the SAC. Mike Cooney has been instrumental in retrieving data from Hanford's many sources for the SAC. Bob Riley leads the release task area, the goal of which is to identify the release of contaminants to the environment

through deliberate disposal actions or accidents, such as spills or leaks. George Last leads the vadose zone task area, which is aimed at understanding the transport and fate of contaminants as they move through the vadose zone. Paul Thorne leads the task of addressing contaminants when they reach the groundwater beneath the Hanford Site. Marshall Richmond leads the final environmental pathway task area, which focuses on understanding contaminants as they move through the Columbia River ecosystem.

The risk and impact task area relies on input from the environmental pathways task areas to provide analyses of the risks to human health, the environment, and the potential impacts to the economic and socio-cultural resources of the Hanford Site and the surrounding region. Amoret Bunn leads this effort, with Charlie Brandt as the ecological risk impact analyst, Bruce Napier as the human health risk analyst, and Mike Scott as the economic risk analyst.

As a result of the team's efforts, the SAC design was publicly released in May 2000 in a BHI report (BHI-01365). "A public comment period followed the release, enabling anyone who wanted to provide input a chance to do so before the software was finalized and the assessment run," Bryce said. Bryce noted that the public comment period was included even though the SAC project did not impact the Tri-Party Agreement.

Additional reviews of the SAC design by SNL, as well as a private engineering consultant, the IPEP, and management were done following the public comment period. "We then set to work to assemble and test the software (computer models) used in the SAC, as well as collect the data for the initial assessment," Bryce said. This aspect of the development of SAC relied heavily on the contributions of computer software developers Paul Eslinger, Will Nichols, and Terri Miley, while Ted Long provided project control.

As a final test, a "history-matching" review was conducted. "The review included such activities as model validation and calibration, that allowed the SAC team to determine how well the assessment would represent the actual environment," Bryce noted.

In the summer of 2001, after more than two years of work, the first assessment using the SAC was run.

#### **DEMONSTRATING THE SYSTEM**

The goal of the initial assessment was to demonstrate that the SAC could be used for an assessment of the scale and scope of the Hanford Site and the Columbia River. The results from this demonstration will be used to design revisions of the SAC.

"By developing revisions of the SAC in several phases, we can ensure that the system components – computer models and data – that contribute the most to our understanding of the risk and impacts of the contaminants remaining at Hanford are included," Bryce said. "This approach also will



From left to right: Amoret Bunn, risk and impact task lead; Charley Kincaid, technical and inventory leads; and Paul Eslinger and Will Nichols, computer software developers.

ensure that DOE and other SAC users have the opportunity to view results at intermediate stages in the development."

The initial assessment was based on the Hanford Site Disposition Baseline, the collection of disposal and remedial actions identified in the Tri-Party Agreement that are planned to occur as the Hanford Site moves toward closure.

In the initial assessment, the movement of 10 radioactive and chemical contaminants from 719 waste sites on the Hanford Site through the vadose zone, groundwater, and the Columbia River was modeled. The 719 waste sites are representative of all of the waste sites on the Hanford Site. Data about the contaminants were obtained from a variety of sources, including monitoring activities, contaminant inventory, Hanford historical records, and existing databases.

The 10 contaminants included tritium, technetium-99, iodine-129, uranium-238, strontium-90, cesium-137, plutonium-239-240, carbon tetrachloride, chromium, and total uranium. The initial assessment focused on how the 10 contaminants are predicted to move through the soil and groundwater at Hanford toward the Columbia River from 1944, when the first contaminants were introduced at Hanford, to 3050 -- 1,000 years after closure of the Hanford Site.

The geographic region examined included the Hanford Site from Rattlesnake Mountain to the Columbia River, and from the Vernita Bridge to the McNary Dam on the Columbia River on the border of Washington and Oregon. This area was chosen because it is the portion of the Columbia River most likely to be impacted by Hanford contaminants.

Atmospheric or terrestrial biological transport pathways through which contaminants may move also were not included in the initial assessment. Atmospheric pathways include gases released from facilities and contaminated dust that move through the air and can deposit on soil and plants. Contaminants transported in this way can affect living organisms through inhalation, direct exposure, and consumption. Terrestrial biological transport pathways include deep-rooted plants and burrowing animals that can bring contaminants to the ground surface. Both of these pathways will be considered for inclusion in revisions of the SAC.

The data were entered into the computer models to predict the impacts to human health and the health of fish, birds, mammals, and plants in the surrounding region. Different exposure scenarios were used to estimate the impacts of the future contaminant movement and distribution to the region's economy and cultures. Then, 11 different "realizations" were completed. Each realization is an equally possible representation of Hanford's system created by selecting specific inventory, environmental transport, and risk parameters from a set of likely values.

#### PROVING THE PRINCIPLE

"The initial assessment was a successful proof-ofprinciple demonstration of the SAC. It showed that the SAC could be used to perform an assessment of the scale and the scope of the Hanford Site, and it provided information needed to design the next revision of the SAC," said Bryce.

"For example, the demonstration showed that a more realistic representation of groundwater flow and transport is needed in the next revision of the SAC to better match field observations. It also identified the need to revise calculations so additional computer processors can be used. This, in turn, will shorten the time it takes to complete realizations. These will be addressed in the next version of the SAC," Bryce noted.

In addition, the initial assessment provided insights that can be used to make decisions about investments in S&T and characterization needs on the Hanford Site. "The results also can be used to identify where improvements in characterization methods and tools are needed. For example, the demonstration showed where additional waste inventory data and improvements in specific computer models are needed. Both of these will be considered in the next revision of the SAC," Bryce added.

Examples of the impacts to human health and the environment that may result after Hanford Site closure also were provided by the initial assessment. However, several improvements to the modeling system need to be made before these results will be meaningful.

The team has begun work on these improvement, and several activities are planned in coming months. "First, we plan to re-run the initial assessment after several issues identified last year are resolved. We also will examine the input of changes to the remediation baseline," Bryce said.

Bryce noted that the hardware will be upgraded to include a multiprocessor computer that will reduce the time required to complete the large number of computations needed for a SAC analysis.

Upgrades to the software also are planned so it will operate efficiently on the multiprocessor machine and allow more realistic modeling of contaminant movement in groundwater.

"Together, these efforts will drastically reduce the time needed to run a realization of the SAC from days to hours," Bryce said.

The staff also will begin working on several documents. "We will summarize the results of the initial assessment. We also will develop user guides for each module of the SAC software to document software features, allow training of new users and facilitate review and improvement to the capability."

# EARNING RECOGNITION FOR THE EFFORT

The SAC has earned high marks for its work to date. One example is the commendation received from the SNL peer review team. They noted "The complexity of the SAC objective to implement a probabalistic system assessment for the Hanford Reservation exceeds that of other similar probabalistic system assessment methodology (PSAM) applications for deep geologic repositories like WIPP, YMP, or other international programs."

The peer review team further noted "The need to include sources at different locations, source movement between locations, source export, source import, previously leaked/released contaminants, multiple system-level consequences, and the current exercise of matching calculated results with a wealth of historical information are examples of additional complexity. The requirement that legacy models be used instead of possibly more computationally efficient models places a burden on the SAC PSAM implementation that other programs have not experienced. In spite of this and with comparatively less resources, the SAC team has successfully designed a system architecture of linked science-based models and implemented the approach, and we commend them on this accomplishment."

Recognition for the SAC also has been received from the Integration Project Expert Panel. In the report from its September 2001 meeting, the eightmember panel noted "The computed results will need to be modified as more precise information is obtained for a final report; however, the intended outcome of proof of the SAC concept in Rev. 0 (the initial assessment) was well demonstrated. Of particular interest was the degree to which the model can already be used to allow users to make some preliminary observations and draw insights that will help in planning future work."

"We are very pleased with these responses to the SAC," Bryce noted. "We have also had very positive discussions with DOE programs, regulators, Tribal Nations, stakeholders and the public on the results seen to date and on plans for development and use of site-wide assessments performed with the SAC."

### FOR MORE INFORMATION

# GENERAL INFORMATION ABOUT THE GROUNDWATER/VADOSE ZONE INTEGRATION PROJECT

Published reports and documents, along with many other sources of background information on the Integration Project, are available at the following Internet locations:

Integration Project home page: http://www.bhi-erc.com/projects/vadose/

Hanford Site home page: http://www.hanford.gov/

Office of River Protection home page: http://www.hanford.gov/orp/index.html

Hanford stakeholders: http://www.hanford.gov/misc\_info/stakehld.htm

The Integration Project home page has links to other DOE, national laboratory, and community or stakeholder sites that have information related to the Hanford Site and environmental remediation work.

# FURTHER INFORMATION ON SIGNIFICANT EVENTS AND FEATURES IN THIS REPORT

Further information on the workshops for investigators in the EMSP is available on the Internet at <a href="http://www.pnl.gov/emsp/">http://www.pnl.gov/emsp/</a>. Information about the EMSP (in general) can be found on the Internet at <a href="http://emsp.em.doe.gov">http://emsp.em.doe.gov</a>.

The 200 Area Implementation Plan (200 Areas Remedial Investigation/Feasibility Study Implementation Plan - Environmental Restoration Program, DOE/RL-98-28, Rev. 0, April 1999) is available through the ER Project Internet Library, at http://www.bhi-erc.com/library/doerl/rl98-28.pdf.

Information on the Science and Technology Endeavor is available on the Internet at <a href="http://www.bhi-erc.com/projects/vadose/s&t.htm">http://www.bhi-erc.com/projects/vadose/s&t.htm</a>.

Documents and reports by the System Assessment Capability Endeavor are available on the Internet at <a href="http://www.bhi-erc.com/projects/vadose/sac/sacdocs.htm">http://www.bhi-erc.com/projects/vadose/sac/sacdocs.htm</a>.

Peer review and technical review activities are described on the Internet at <a href="http://www.bhi-erc.com/projects/vadose/peer.htm">http://www.bhi-erc.com/projects/vadose/peer.htm</a>. The agenda, closeout comments, and meeting reports for the IPEP are available on the Internet at <a href="http://www.bhi-erc.com/projects/vadose/peer/ipep.htm">http://www.bhi-erc.com/projects/vadose/peer/ipep.htm</a>.

For more information, or to become involved with the Integration Project, please contact Barbara Howard at (509) 372-9236.



www.bhi-erc.com/projects/vadose